PATENT APPLICATION

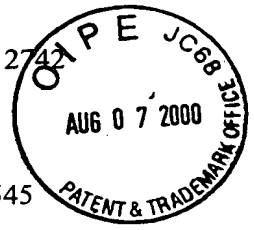
#5

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Roman VITENBERG

Group Art Unit: 2742



Application No.: 09/599,406

Filed: June 22, 2000

Docket No.: 106545

For: DIGITAL SUBSCRIBER LINE COMMUNICATION SYSTEM

CLAIM FOR PRIORITY

Director of the U.S. Patent and Trademark Office
Washington, D.C. 20231

Sir:

The benefit of the filing dates of the following prior foreign applications filed in the following foreign country(ies) is hereby requested for the above-identified patent application and the priority provided in 35 U.S.C. §119 is hereby claimed:

Israel Patent Application No. 134401 filed February 6, 2000;
Israel Patent Application No. 136781 filed June 15, 2000.

In support of this claim, certified copies of said original foreign applications:

__X__ are filed herewith.

_____ were filed on _____ in Parent Application No. _____ filed _____.

It is requested that the file of this application be marked to indicate that the requirements of 35 U.S.C. §119 have been fulfilled and that the Patent and Trademark Office kindly acknowledge receipt of these documents.

Respectfully submitted,

James A. Oliff
Registration No. 27,075

Mario A. Costantino
Registration No. 33,565

JAO:MAC/kmr

Date: August 7, 2000

OLIFF & BERRIDGE, PLC
P.O. Box 19928
Alexandria, Virginia 22320
Telephone: (703) 836-6400

DEPOSIT ACCOUNT USE AUTHORIZATION
Please grant any extension necessary for entry;
Charge any fee due to our Deposit Account No. 15-0461

מדינת ישראל
STATE OF ISRAEL

Ministry of Justice
Patent Office

משרד המשפטים
לשכת הפטנטים

This is to certify that annexed hereto is a true copy of the documents as originally deposited with the patent application of which particulars are specified on the first page of the annex.

זאת לתעודה כי רצופים בזה העתקים נכונים של המסמכים שהופקדו לכתחילה עם הבקשה לפטנט לפי הפרטים הרשומים בעמוד הראשון של הנספח.

[redacted]

This 26-06-00 היום

רשם הפטנטים

Commissioner of Patents

נתאשר
Certified

CERTIFIED COPY OF PRIORITY DOCUMENT

חוק הפטנטים, התשכ"ז–1967
PATENTS LAW, 5727–1967

בקשה לפטנט
Application for Patent

לשימוש הלשכה
For Office Use

מספר: Number	134401
תאריך: Date	06-02-2000
הוקדם/נדחה Ante/Post-dated	

אני, (שם המבקש, מענו – ולגבי גוף מאוגד – מקום התאגדותו)
I (Name and address of applicant, and, in case of body corporate-place of incorporation)

בעל אמצאה מכח ROMAN VITENBERG ששמה הוא
Owner, by virtue of of an invention, the title of which is

(בעברית)
(Hebrew)

" DIGITAL SUBSCRIBER LINE COMMUNICATION SYSTEM (DSLCS) AND METHOD THEREFORE."

(באנגלית)
(English)

מבקש בזאת כי ינתן לי עליה פטנט
hereby apply for a patent to be granted to me in respect thereof.

* בקשת חלוקה – Application of Division	* בקשת פטנט מוסף – Application for Patent Addition	* דרישה דין קדימה Priority Claim		
מבקשת פטנט from Application	* לבקשה/לפטנט to Patent/Appl.	מספר/סימן Number/Mark	תאריך Date	מדינת האגוד Convention Country
No. מס'	No. מס'			
dated מיום	dated מיום			

* יפוי כח: כללי/מיוחד – רצוף בזה / עוד יוגש
P.O.A.: general / individual – attached / to be filed later –

filed in case הוגש בענין

המען למסירת הודעות ומסמכים בישראל
Address for Service in Israel
HADAR ST. 9 APT. 6 HOLON
58210 ISRAEL

חתימת המבקש
Signature of Applicant

היום This _____ בחודש of _____ שנת of the year _____

לשימוש הלשכה
For Office Use

DIGITAL SUBSCRIBER LINE COMMUNICATION SYSTEM (DSLS) AND METHOD THEREFORE.

מערכת תקשורת דיגיטלית למנויים ושיטות נוספות.

ABSTRACT

A digital subscriber line communication system on telephone cable comprises number of office xDSL modems placed at CO and connected to telephone cable and number of subscriber premises placed in the building and coupled by into-building telephone lines to a Local Box that connected to said telephone cable, each subscriber premise comprises number of information devices connected to telephone line by HPN interface. A number of xDSL/HPN Subscriber Converters placed into said Local Box,. Each Subscriber Converter connected to twisted pair of telephone cable and to corresponding flat into-building telephone line to provide a local subscriber loop. Each Subscriber Converter includes a Splitter-Isolator to separate xDSL and HPN signals and to provide uninterrupted POTS (and ISDN) service. A communication system comprises a Video-Server connected to each Subscriber Converter to provide video on demand service .

FIELD OF THE INVENTION

The invention relates in general to voice and data communication, and more particularly to a communication System on existing twisted pair telephone cable, which uses Digital Subscriber Line (DSL) technology.

BACKGROUND OF THE INVENTION

Existing Plant Old Telephone Service (POTS) ,which basis on twisted pair telephone cable is a most wide-spread information system in the World. In during more than one hundred years after invention of telephone apparatus by Bell the telephone service persistent extends. New kinds of telephone services like cellular telephone or telephone over Internet appears in during last years, but cables network will be dominant information system in 21 Century.

Many new technologies developed in during 20 Century for POTS, from electronic telephone commutations to fiber cable, from Gigabit switches to PCM

Telephone system. Many new services like Internet or LAN use existing telephone channels. In during last 10 years was developed principally new technology of digital multitone signals that permissions to convert existing twisted pair telephone subscriber lines into access paths for multimedia and high speed data communications. A most successful Asymmetric Digital Subscriber Line (ADSL) transmits more than 8 Mb/s to a subscriber premise, and as much as 1040 kb/s more in both directions. Such rates expand existing access capacity by actor of 50 or more without new cabling. ADSL can practically transform the existing public information network from one limited to voice, text and low resolution graphics to a powerful, ubiquitous system capable to bringing multimedia, including full motion video, to every home.

An ADSL circuit connects an ADSL modem on each end of twisted-pair telephone line, creating three information channels - a high speed downstream channel, a medium speed duplex channel , and a POTS (Plain Old Telephone Service) channel. The POTS channel is splits off from the digital modem by filters, thus guaranteeing uninterrupted POTS, even if ADSL fails. The high-speed downstream channel supports bit rate from 1.5 to 8 Mb/s, while duplex channel supports rate range from 16 to 1040 kb/s. Downstream data rate depend on number of factors, including the length of the copper line, its wire gauge, presence of bridged taps, and cross-coupled interference. Line attenuation increases with line duration and frequency, and decreases as wire diameter increases. Ian typical ADSL will perform as follows:

DATA RATE	WIRE SIZE	DISTANCE
1.5 Mb/s	0.5 mm	5.5 km
1.5 Mb/s	0.4 mm	4.6 km
8 Mb/s	0.5 mm	3.7 km
8 Mb/s	0.4 mm	2.7 km

One of the problems of ADSL is necessary to rewire existing telephone home network inside subscriber premise and to put special splitter device for dividing voice and ADSL signals at subscriber premise. For eliminate splitter and rewiring of home network, was developed G.Lite ADSL system, in which separating of ADSL and voice signals realizes by putting special microfilters in serial with every Home Telephone Set. But the G.Lite system supports only 1.5 Mb/s data rate in downstream direction that make unacceptable video on demand service. More, the microfilter, placed in serial with telephone decreases quality of voice communication.

Another problem of ADSL is into-building wiring, which was not designed to high-speed data communication. Practically, for into-building wiring is used flat pair cable, which has unpredictable characteristic and is very sensitive to RF noise.

Another problem of ADSL is that a customer must have an ADSL home modem and a personal computer at the subscriber premise. Every device in the home, which is needed high- speed data service from Telephone Station, like: Video-Phone, Digital TV, HI-FI Digital Audio, must be connected to ADSL home modem only through personal computer. Practically it means that in home must be two independent networks: existing telephone network and additional digital data network.

Another problem of ADSL is that only one home modem may talk with office modem at the same time. If subscriber has several computers, only one from them may be connected to telephone line.

SUMMARY OF THE INVENTION

In accordance with the present invention, the disadvantages and problems associated with ADSL system have been substantially reduced or eliminated. In particular, a "DIGITAL SUBSCRIBER LINE COMMUNICATION SYSTEM" (DSLCS) provides voice and data service to subscriber premise using existing into-building wiring without installation any special communication equipment inside subscriber premise. Any device in the home that needs high speed data service from Telephone Station, like: Video Phone, Digital TV, HI-FI Digital Audio, Personal Computers and e.g., may be connected directly to existing telephone jacks inside customer apartment. A Common telephone and fax apparatus may be connected to the same jacks. Practically, customer may not know anything's about Subscriber Telecommunication System that he uses. A Customer no needs ADSL modem and may get some special data services (for example, for Digital TV or HI-FI Digital Audio Broadcast) without using of PC.

The main Principe of the present invention is to use a special Subscriber Converter, placed into subscriber building and connected between a into-building part and a cable part of the same subscriber local loop. A Subscriber Converter uses different communication methods (standards) and different line signals on the into-building part and cable part of the same subscribers local loop. A subscriber Converter comprises Splitter-Isolator device that separates data signals on the into-building part and cable part of the same subscriber local loop and provides uninterrupted POTS telephone service.

A number of Subscriber Converters, placed into a Local Building Communication Box (Local Box), provide voice and data service to a corresponding number of subscribers premises of the services building. An existing telephone cable and into-building wiring are connected to a Local Box.

In accordance with basis embodiment of the present invention a Subscriber Converter comprises a xDSL AFE (Analog Front End) device connected to twisted pair of telephone cable; a HPN (Home Phoneline Network) AFE device connected to flat (or twisted) pair of into-building wiring ; and digital xDSL/HPN Converter device. A

digital xDSL/HPN Converter device provides data exchange between xDSL AFE device and HPNA AFE device to realize communication between Central Office equipment and subscribers premise equipment. A Subscriber Converter comprises Splitter-Isolator device separates HPN and xDSL line signals those are transmitted over different parts of subscriber local loop, and provides uninterrupted POTS telephone service.

A Subscriber Converter in one embodiment further comprises a Computer-Server connected to said digital xDSL/HPN Converter device.

A Subscriber Converter in another embodiment further comprises an digital interface port , for example Ethernet port , connected to said Computer-Server .

One of xDSL standards (for example ADSL standard) , those were developed for communication over twisted pair telephone cable, is using for communication between a Subscriber Converter and Central Office (CO) of Telephone Station.

One of HPN standards (for example HPNA-2 standard) , those were developed for communication over flat (or twisted) pair into-building wiring , is using for communication between a Subscriber Converter and subscriber premise.

In accordance with another embodiment of the present invention the communication system further comprising a Video-Server device, placed into Local Box and connected to each Subscriber Converter by said interface digital port.

In accordance with another embodiment of the present invention the communication system further comprising :

A satellite TV broadcast antenna placed on the roof of the said building , and

A satellite TV broadcast Receiver (TV-Receiver) connected to said satellite TV broadcast antenna , and

A video MPEG Encoder connected to said receiver, and

A digital Video-Multiplexer connected to MPEG encoder and to said Video-Server device.

In accordance with another embodiment of the present invention the communication system further comprising :

A number of cable TV receivers (Cable Receiver) connected to number of cable TV providers by coaxial cable , and

A number of video MPEG Encoders connected to number of said receivers, and

A digital Video-Multiplexer connected to number of said MPEG Encoders and to said Video-Server device.

In accordance with another embodiment of the present invention the communication system further comprising :

A Fiber-Optic Receiver connected to fiber-optic line and to said Video-Server device.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, and for further features and advantages, reference is now made to the following description taken in conjunction with the accompanying drawings, in which :

FIG.1 illustrates DSLCS in basic embodiment.

FIG.2 illustrates a Subscriber Converter in basic embodiment.

FIG.3 illustrates one embodiment of DSLCS.

FIG.4 illustrates one embodiment of a Subscriber Converter.

FIG.5 illustrates another embodiment of DSLCS.

FIG.6 illustrates another embodiment of DSLCS.

FIG.7 illustrates a Video-Server device in one embodiment.

FIG.8 illustrates another embodiment of DSLCS.

FIG.9 illustrates another embodiment of DSLCS.

FIG.10 illustrates another embodiment of DSLCS.

DETALED DESCRIPTION OF THE INVENTION

Fig. 1 illustrates Digital Subscriber Line Communication System in accordance with basic embodiment of present invention.

The communication system **101** comprises Central Office (CO) **103** of telephone station, coupled to services building **107** by twisted pair telephone cable **105**. A number of xDSL office modems **106** placed on CO **103** connected to number of twisted pairs **121** of telephone cable **105**. Each xDSL modem **106** is connected to telephone network **135** and to data network **137** to provide data and POTS service to corresponding subscriber. The building **107** comprises number of subscriber premises **109** and Local Box **123**. The Local Box **127** is coupled to CO **103** by telephone cable **105** and to each subscriber premise **109** by into-building flat (or twisted) pair **111**. Each subscriber premise comprises telephone **115** and number of Personal Computers (PC) **113**. Each PC **113** is connected directly to subscriber telephone line **119** and includes internal HPN (Home Phoneline Network) interface device **114**. The telephone **115** is directly connected to the same telephone line **119**.

The Local building box **123** comprises number of xDSL/HPN Subscriber Converters **125**. Each Subscriber Converter **125** is connected to corresponding subscriber premise **109** by into-building flat (or twisted) pair **111** and to corresponding office xDSL modem **106** by corresponding subscriber twisted pair **121** of telephone cable **105**.

Fig.2 illustrates a Subscriber Converter in accordance with basic embodiment of present invention.

The Subscriber Converter **125** comprises a Splitter-Isolator **203**, connected between input connector **205** and output connector **207**, xDSL AFE device **209** coupled to input connector **205**, HPN AFE device **211** coupled to output connector **207**, and digital xDSL/HPN Converter device **213** coupled to xDSL AFE device **209** and to HPN AFE device **211**. A Computer-Server **215** is coupled to said digital xDSL/HPN Converter device **213** and to digital Interface Port **217**.

An input connector **205** is connected to twisted pair **121** of telephone cable , an output connector **207** is connected to flat (or twisted) pair **111** of into-building wiring. A twisted pair **121**, xDSL/HPN Converter and flat (or twisted) pair **111** provides a local loop to subscriber premise.

The communication system **101** provides voice and digital data service to every subscriber premise **109** of the building **107**. Voice signals from telephone network 135 come to subscriber twisted pair **121** of telephone cable **105** through POTS-Splitter of CO xDSL Equipment. Data signals from data network **137** are converted to xDSL line signals by office modem **106** and come to the same subscriber twisted pair **121**. A CO uses standard xDSL equipment like ADSL (VDSL) modems and works in the same way as existing ADSL (VDSL) system. Voice signals from telephone **115** inside subscriber premise come to a flat (or twisted) pair **111** of into-building wiring. Data signals from PC **113** are converted to HPN line signals by HPN interfaces block **114** and come to the same flat (or twisted) pair **111** of into-building wiring. Voice signals passes without attenuation through Splitter-Isolator **203** of Subscriber Converter **125**. A convention of HPN line signals to ADSL line signals carries out inside Subscriber Converter **125.** HPN line signals are converted into digital form by HPN AFE device **211** and passes to Digital xDSL/HPN Converter device **213** , that realizes digital signal processing of digital HPN signals and decodes information data . An information data stores into internal memory. Another part of Digital xDSL/HPN Converter device **213** reads information data from internal memory and realizes digital signal processing to convert said data to discrete xDSL signals. A xDSL AFE device **209** converts discrete xDSL signals to analog xDSL line signals. A Computer-Server **215** realizes data exchange with internal memory of digital xDSL/HPN Converter device **213** and store database information, which may be used by customer . For example, Computer-Server may be programmed by customer to store and automatically update by Internet some news, sport information, business information and e.g. A digital Interface Port **217** may be used for many additional services as will be further described. A conversion of line xDSL signal, received from CO to HPN line signal realizes by Subscriber Converter **125** in the same way. Received xDSL signal converts by xDSL AFE device **209** into discrete form and processes by digital xDSL/HPN Converter device **213** to decode an information data. An

information data stores into internal memory. Another part of Digital xDSL/HPN Converter device **213** reads information data from internal memory and realizes digital signal processing to convert said data to discrete HPN signals. A HPN AFE device **209** converts discrete HPN signals to analog HPN line signals.

The communication system, described above, includes several technical advantages in comprising with existing DSL system.

a) The DSLCS not needed in rewiring of existing into-building wires, like full rate ADSL and no need in microfilters, like splitterless ADSL.

b) The DSLCS has very high performance of xDSL communication with CO, because it uses twisted pair of telephone cable directly connected to input of Subscriber Converter. Such connection decreases noise and RF interference on xDSL line and terminates bridge tapes problem, which is common for splitterless ADSL.

c) Every PC in the subscriber premise may be connected to CO at the same time using xDSL/HPN Converter.

d) Any device in the home that needs high speed data service from Telephone Station, like: Video Phone, Digital TV, HI-FI Digital Audio, and e.g., may be connected directly to existing telephone jacks inside customer apartment. A customer no needs personal computer for getting such services.

e) A Computer-Server of a Subscriber Converter may support many different services for customer. Particularly, said Computer-Server may replace customers PC. In this case only simple Terminal Device may be placed at subscriber premise. Said Terminal Device may execute function of Video-Phone, function of personal computer, function of Internet Information device, function of remote control of different home mechanisms.

The basis embodiment of present invention may be realized in several versions with using different xDSL (ADSL, VDSL, SDSL, HDSL) and HPN (HPNA-1, HPNA-2, NDSL) standards and line signals.

Fig.3 illustrates one embodiment of present invention that uses ADSL DMT standard for communication to CO and HPNA-2 standard for communication inside building. The communication system **301** supports home network communication with

bit rate 10 Mb/s , a Downstream from CO with bit rate up to 10 Mb/s (for 3 km distance) and an Upstream to CO with bit rate 1 Mb/s.

The communication system **301** comprises Central Office (CO) **303** of telephone station, coupled to services building **307** by twisted pair telephone cable **305**. A number of ADSL office modems **306** placed on CO **303** are connected to number of twisted pairs **321** of telephone cable **305**. Each ADSL modem **306** is connected to telephone network **335** and to data network **337** to provide data and POTS service to corresponding subscriber. The building **307** comprises number of subscriber premises **309** and Local Box **323**. The Local Box **327** is coupled to CO **303** by telephone cable **305** and to each subscriber premise **309** by into-building flat (or twisted) pair **311**. Each subscriber premise comprises telephone **315** and number of Personal Computers (PC) **313**. Each PC **313** is connected directly to subscriber telephone line **319** and includes 10 MHz Home Phoneline Network Alliance (HPNA-2) interface device **314**. The telephone **315** is directly connected to the same telephone line **319**.

The Local building box **323** comprises number of ADSL/HPNA-2 Subscriber Converters **325**, each Subscriber Converter **325** is connected to corresponding subscriber premise **309** by into-building flat (or twisted) pair **311** and to corresponding office ADSL modem **306** by corresponding subscriber twisted pair **321** of telephone cable **305**.

Fig.4 illustrates a Subscriber Converter in accordance with said embodiment of present invention.

The Subscriber Converter **325** comprises a Splitter-Isolator **403** , connected between input connector **405** and output connector **407**, ADSL AFE device **409** coupled to input connector **405** , HPNA-2 AFE device **411** coupled to output connector **407**, and digital ADSL/HPNA-2 Converter device **413** coupled to ADSL AFE device **409** and to HPNA-2 AFE device **411**. A Computer-Server **415** is coupled to said digital ADSL/HPNA-2 Converter device **413** and to digital Interface Port **417.**

An input connector **405** is connected to twisted pair **321** of telephone cable , an output connector **407** is connected to flat (or twisted) pair **311** of into-building wiring. A twisted pair **321**, ADSL/HPNA-2 Converter **325** and flat (or twisted) pair **311** provides a local loop to subscriber premise.

A Splitter-Isolator **403** comprises high-pass filter **421**, low pass filter **423** and HPN line transformer **425**. An input ADSL signal from twisted pair **321** of telephone cable comes to input of ADSL AFE device **409** through high pass filter capacitors **425**. An input voice signal comes to output connector **407** without attenuation through low-pass filter **423**, because frequency diapason of voice signals is about 0.3 - 4 kHz and bandwidth of low-pass filter **423** is about 8kHz . ADSL line signals are allocated in diapason 30kHz - 1.1MHz , HPNA-2 signals are allocated in diapason 4MHz- 10MHz. The low-pass filter **423** has high attenuation for ADSL and HPNA-2 signals (about 60 - 80 dB) and isolates line signals on into-building part and cable part of subscriber local loop. HPNA-2 signals are inserts on flat (or twisted) into-building pair **311** by HPN line transformer **425**, which has very low impedance for voice signals. An output capacitor **427** of low pass filter **423** has very low impedance for HPNA-2 signals.

ADSL AFE device **409** comprises ADSL line transformer **429**, Line Driver IC **431**, and ADSL AFE IC **433**. Resistors **435** are using for matching of device **409** impedance with impedance of twisted pair **321**. A Line Driver **431** is one from popular IC's, which was developed for ADSL by Texas Instrument (THS6012, THS6022) , by Analog Devices (AD8016, AD8012). An ADSL AFE IC **433** is one from devices, which was developed by Texas Instrument, by Analog Devices . An ADSL AFE IC **433** comprises analog receiver filter **451**, analog transmitter filter **453**, Analog to Digital Converter (ADC) **455**, Digital to Analog Converter **457** and Digital Parallel Interface block **459**. An ADSL AFE IC **433** converts received DMT signals to 14 bit output digital words, and produces analog DMT signals from 14 bit input digital words. An input digital word comes to AFE IC **433** by input bus **461.** An output digital word goes on output bus **463**.

A HPNA-2 AFE device **411** is one from IC's, which was developed for HPNA-2 by Epigram , by Lucent , by Broadcom . A HPNA-2 AFE device **411** comprises Line Driver **465**, a receives filter **467**, Analog to Digital Converter (ADC) **469**, Digital to Analog Converter **471** and Digital Parallel Interface block **473**. An HPNA-2 AFE IC **411** converts received QAM signals to 12 bit output digital words, and produces transmitted QAM signals from 12 bit input digital words. An input digital word comes to HPNA_2 device **411** by input bus **475**. An output digital word goes on output bus **477**.

A digital ADSL/HPNA-2 Converter device **413** is a VLSI Circuit. This device comprises first DSP **479** and first program Memory **481** that includes micro-program of ADSL signals processing, second DSP **483** and second program Memory **485** that includes micro-program of HPNA-2 signals processing , data exchange controller **487**, buffer RAM **489** and control processor **491**. A first DSP **479** works by controlling of first program memory **481** and connected to ADSL AFE IC **433** by input bus **461** and by output bus **463**. A second DSP **483** works by controlling of second program memory **485** and connected to HPNA-2 AFE IC **411** by input bus **475** and by output bus **477**.

A Computer-Server **415** comprises CPU **495**, program/data memory **497** and hard-disk **499**. A Computer-Server **415** is connected to a control processor **491** of digital ADSL/HPNA-2 Converter device **413** and to digital Interface Port **417** by PCI bus **493**.

The communication system **301** provides voice and digital data service to every subscriber premise **309** of the building **307**. Voice signals from telephone network **335** come to subscriber twisted pair **321** of telephone cable **305** through POTS-splitter of CO ADSL equipment. Data signals from data network **337** are converted to ADSL DMT line signals by office modem **306** and come to the same subscriber twisted pair **321**. A CO uses standard ADSL modems and works in the same way as existing ADSL system. Voice signals from telephone **315** inside subscriber premise come to a flat (or twisted) pair **311** of into-building wiring. Data signals from PC **313** are converted to QAM line signals by HPNA-2 interface block **314** and come to the same flat (or twisted) pair **311** of into-building wiring. Voice signals passes without attenuation through Splitter-Isolator **403** of Subscriber Converter **325**. A convention of QAM line signals to DMT line signals provides inside Subscriber Converter **325**. The QAM line signals are converted into digital form by HPNA-2 AFE IC **411** and passes to second DSP 483 of Digital ADSL/HPNA-2 Converter IC **413** that realizes digital signal processing of digital QAM signals and decodes information data . An information data stores into internal memory. First DSP 479 of Digital xDSL/HPN Converter IC **413** reads information data from internal memory and realizes Digital signal processing to convert said data to discrete DMT signals. A ADSL AFE device **409** converts discrete DMT signals to analog DMT line signals. A Computer-Server **415** realizes data exchange with internal

memory of digital ADSL/HPN Converter IC **413** and store database information, which may be used by customer . For example, Computer-Server may be programmed by customer to store and automatically update by Internet news, sport information, business information and e.g. A digital Interface Port **417** may be used for many additional services as will be further described. A conversion of line DMT signal, received from CO to QAM line signals provides by Subscriber Converter **325** in the same way. Received DMT signals converts by ADSL AFE device **209** into discrete form and processes by first DSP 479 of digital ADSL/HPNA-2 Converter device **413** to decode an information data. An information data stores into internal memory . Second DSP 483 of Digital ADSL/HPNA-2 Converter device **213** reads information data from internal memory and realizes Digital signal processing to convert said data to discrete QAM signals. A HPNA-2 AFE device **209** converts discrete QAM signals to analog QAM line signals.

A Computer-Server **415** of a Subscriber Converter **325** may supports many different services for customer. Particularly, said Computer-Server may replace customers PC. In this case only simple Terminal Device may be placed at subscriber premise. Said Terminal Device may execute function of Video-Phone, function of personal computer, function of Internet Information device, function of remote control of different home mechanisms.

FIG.5 illustrates one embodiment of subscribers part of DSLCS in accordance with present invention.

A Local Box **323** is connected to telephone cable **305** and provides data and voice to number of subscriber premises **308, 309, 310**. Each subscriber premise connected to individual Subscriber Converter **325** by into-building pair **311**. Different customer devices are connected at different subscriber premises. The subscriber premise **309** comprises two PCs **313** that are connected to telephone line **319** by HPNA-2 interface blocks **314** and common telephone **315**. The subscriber premise **308** comprises Video-Phone **354** and IP-Telephone **355** are connected to telephone line **319** by HPNA-2 interface blocks **314**, and common telephone **315**. An IP-Telephone **355**, a Video-Phone **354** and a Telephone **315** may work simultaneously to provide three voice channels over subscriber local loop. Number of IP-Telephones that may be connected to

subscriber local loop practically is not limited (more than 20 units). A Video-Phone **354** may .work together with Computer-Server of Subscriber Converter **325**. In this case a Video-Phone may support Internet service to customer.

The subscriber premise **310** comprises HD-TV **335**, Terminal Device **337**, DVD Player **341**, digital audio Type-Recorder **339** are connected to telephone line **319** by HPNA-2 interface blocks **314**, and common telephone **315**. The Subscriber premise **310** comprises wireless set-top box **343** that controls different home devices and mechanism's by RF frequency.

An HD-TV **335** may get as video program from CO so video film from DVD Recorder **341**. A Terminal device **337** works together with Computer-Server of Subscriber Converter to replace PC and may control every device connected to telephone line **319**. As understood, Subscriber Converter is always-connected device and may be programmed by Terminal device **337** to monitor different home devices and mechanism's using wireless set-top box **343**.

Many other further services may be provided by DSLCS without placing a PC at subscriber premise, for example: printing newsletter or interesting for customer news, mailing service, fax service, Internet and e.g.

Fig.6 illustrates Digital Subscriber Line Communication System in accordance with one embodiment of present invention.

The communication system **601** comprises Central Office (CO) **303** of telephone station, coupled to serviced building **307** by twisted pair telephone cable **305**. A number of ADSL office modems 306 placed on CO **303** are connected to number of twisted pairs **321** of telephone cable **305**. Each ADSL modem is connected to telephone network 335 and to data network **337** to provide data and POTS service to corresponding subscriber. The building **307** comprises number of subscriber premises **309** and local building communication box **323**. The local building box **323** is coupled to CO **303** by telephone cable **305** and to each subscriber premise **309** by into-building flat (or twisted) pair **311**. Each subscriber premise comprises telephone **315**, HDTV television Set **335** and Personal Computers (PC) **313**. A HDTV television Set **335** is connected directly to subscriber telephone line **319** and includes MPEG Decoder **351** and HPNA-2 interface device **314.** PC **313** is connected directly to subscriber telephone line

319 and includes HPNA-2 interface device 314 . The telephone 315 is directly connected to the same telephone line 319.

The Local building box 323 comprises number of ADSL/HPNA-2 Subscriber Converters 325 , each Subscriber Converter 325 is connected to corresponding subscriber premise 309 by into-building flat (or twisted) pair 311 and to corresponding office ADSL modem 306 by corresponding subscriber twisted pair 321 of telephone cable 305.

The Local building box 323 comprises Video-Server 375 connected to each Subscriber Converter 325 by its Interface Port 417 and interface cable 379. A Video-Server 375 provides to customer video on demand service, video-library service, data-base service.

Fig.7 illustrates a Video-Server 375 in one embodiment. A Video-Server 375 comprises a big size Memory 501, a Memory Controller 503, a Host Computer 505, number of Interface Controllers 507 corresponding to number of Subscriber Converters 325; each interface controller 507 connected to buffer RAM 509 and to corresponding Subscriber Converter 325 by interface cable 379. Each buffer RAM 509 connected to Memory 501 by bus 511. A high speed interface port 513 connected to Demultiplexer 515. A Interface Port 517 connected to Host Computer 505 and provides control of external Video Equipment that will be described in following. A number of RAM's 519 are connected to Demultiplexer 515 and to Memory 501 by bus 521. A Host Computer 505 controls every device of Video-Server 375 and works by program, stored in its program memory. This program may be loaded from Floppy Disk or from CO, using one of Subscriber Converters. The Host Computer is able to talk with every customer device and with each office xDSL modem, placed at CO. The Host Computer 505 supports video on demand service and video-library service for each customer connected to Local Box 323. A high speed interface port 513 and Demultiplexer 515 are use for connection of external equipment as will be described in following .

a) Video on demand service.

Digital Subscriber Line Communication System Fig.6 provides video on demand service by next way. A customer establish a communication with Computer-Server 415 of his

Subscriber Converter 325 from PC 313 or Terminal Device 337 . After that, a customer is connected to Host computer 505 of Video-Server 375 and may order a Video Film by sending to Host Computer 505 a corresponding Internet URL code. A Video-Server 375 establish communication with Video-Provider **302** connected to Data Network 337 of CO. A Video-Server 375 uses for communication with Video-Provider **302** all Subscriber Converters 325 that are not busy by customers. A Video-Provider **302** transmits video film by data packets with low bit rate, for example 1.5 Mb/s, using ADSL downstream signals of office ADSL modems 306 connected to said Video-Server 375. Each data packet includes ID number that comprises information about transmitted film and serial number of packet. A received by Subscriber Converter data packet goes through Interface Port 417 to the Video-Server 375. An Interface Controller 507 writes said data packet to Buffer RAM 503. A Host Computer 505 reads ID number of data packet stored into each Buffer RAM 503 and writes said packet to Memory 501 in accordance with ID numbers to produce a video film File. After transmission end , a Host Computer inserts name of said file into Catalog and sends to customer corresponding message. A film Catalog is stored in Memory 501 and is acceptable for all customers , connected to Local Box 323.

A customer may see any film from Catalog using Subscriber Converter and HPN interface of HD-TV, placed at subscriber premise.

A Video-Server 375 may realize a video-film loading in during off-peak hours , for example, at night. As understand, a Memory 501 may store not only video-films but any others files that a customer needs. For example , each customer may assignee part of memory for storing a backup of PC, useful books, some program and e.g.

b) Video Library service.

A Video Library service provides by the same Equipment. A Video-Provider **302** uses part of Memory 501 for Video-Library that includes , for example, 20 video films. A provider supports Video Library by transmitting to a Video-Server , for example one new film every night. A provider automatically gets from Video-Server information about customer access to Video-Library that may improve quality of service.

Fig.8 illustrates another embodiment of the invention that supports TV Broadcast service. The communication system 701 comprises TV satellite antenna 369, placed at the roof of building 307 and connected by coaxial cable 365 to TV satellite Receiver 367, placed inside Local Box 323. A TV satellite Receiver 367 connected to MPEG Coder 361 and to Multiplexer 363 that is connected to Video-Server 375. A received TV Broadcast signal does from satellite antenna 369 to TV satellite Receiver 367 that is controlled by Host Computer 505 of a Video-Server 375. A TV satellite Receiver 367 amplifies RF signals and realizes its down conversion to IF frequency. A Receiver 367 comprises multichannel IF demodulator that may be tuned by Host Computer 505 to receive number of TV channels. A multichannel MPEG Coder converts number of video signals to number of data streams. Each data stream has bit rate about 6 Mb/s. Said datastreams unite by Multiplexer 363 to high speed data stream 155 Mb/s. that transmits to high speed interface port 513 of Video-Server 375 by coaxial cable 378. An interface cable 381 connects Receiver 367 to interface port 517 of Video-Server 375.

Each customer may establish a connection of his HD-TV 335 to any of received video-signals by programming of the Demultiplexer 515. A Host Computer realize programming of a Demultiplexer 515 in accordance with commands sent by customer from PC 313. Additionally some video signal may be stored in memory 501, for example news.

Fig.9 illustrates another embodiment of the invention that additionally supports Cable TV. The communication system 901 additionally comprises number of Cable TV Receivers 383 placed into Local box 323 and connected to different Cable TV provides 304 by coaxial cables 385. Each Cable TV Receiver 383 connected to multichannel MPEG Coder 387. A multichannel MPEG Coder 387 connected to Multiplexer 363. A Multiplexer 363 connected to Video-Server 375.

The communication system 901 provide data and voice services from CO, TV Satellite Broadcast service and Cable TV service from several Cable TV providers. A customer gets every TV service only by HPN . It make possible a billing of each service by sending to each provider (by ADSL CO Equipment) a information about using TV channels.

Fig. 10 illustrates another embodiment of the invention that will be very useful in the future. . The communication system 1001 comprises a Fiber Opto Receiver 391 , connected by fiber line 393 to high speed data service provider 395 and to high speed interface port of Video-Server 375. A communication system 1001 uses for Home Network communication 100Mb/s HPNA-3 interface blocks 314. A fiber cable supports bit rate about 155 Mb/s and replaces all TV receiving equipment.

Although the present invention has been described with several embodiments , a myriad of changes, variations, alterations, ,and modifications may be suggested to one skilled in the art, and it is intended that the present invention encompass such changes, variations, alterations , and modifications as fall within the spirit and scope of appended claims .

CLAIMS

The claimed invention is as follows:

1. A digital subscriber line communication system on telephone cable , comprising :

A number of office xDSL modems placed at Central Office (CO) of Telephone Station and connected to number of twisted pair of subscriber telephone cable on the station end ; and

A number of subscriber premises placed in the building and coupled by flat (or twisted) pair into-building telephone lines to a Local Box, each subscriber premise comprises number of information devices connected to telephone line by HPN interface and number of telephone sets directly connected to said telephone line ; and

A said telephone cable coupled on subscriber end to said Local Box; and

A number of Subscriber Converters placed into said Local Box; each Subscriber Converter connected to twisted pair of telephone cable and to corresponding flat (or twisted) pair of into-building telephone line to provide a local subscriber loop; each Subscriber Converter comprises an xDSL AFE device connected to said twisted pair of telephone cable, an HPN AFE device connected to said flat (or twisted) pair of into-building telephone line, a digital xDSL to HPN Converter device connected to xDSL AFE device and to HPN AFE device, and a Splitter-Isolator that connected between said twisted pair of telephone cable and said into-building flat (or twisted) pair to separate xDSL and HPN signals and to provide uninterrupted POTS and (ISDN) service.

2. A digital subscriber line communication system on telephone cable , comprising :

A number of office ADSL modems placed at Central Office (CO) of Telephone Station and connected to number of twisted pair of subscriber telephone cable on the station end ; and

A number of subscriber premises placed in the building and coupled by flat (or twisted) pair into-building telephone lines to a Local Box, each subscriber premise comprises number of information devices connected to telephone line by HPNA-2 interface and number of telephone sets directly connected to said telephone line ; and

A said telephone cable coupled on subscriber end to said Local Box; and

A number of Subscriber Converters placed into said Local Box; each Subscriber Converter connected to twisted pair of telephone cable and to corresponding flat (or twisted) pair of into-building telephone line to provide a local subscriber loop; each Subscriber Converter comprises an ADSL AFE device connected to said twisted pair of telephone cable, an HPN A-2 AFE device connected to said flat (or twisted) pair of into-building telephone line, a digital ADSL to HPNA-3 Converter device connected to ADSL AFE device and to HPNA-2 AFE device, and a Splitter-Isolator that connected between said twisted pair of telephone cable and said into-building flat (or twisted) pair to separate ADSL and HPNA-2 signals and to provide uninterrupted POTS and (ISDN) service.

3. A digital subscriber line communication system on telephone cable , comprising :

A number of office VDSL modems placed at Central Office (CO) of Telephone Station and connected to number of twisted pair of subscriber telephone cable on the station end ; and

A number of subscriber premises placed in the building and coupled by flat (or twisted) pair into-building telephone lines to a Local Box, each subscriber premise comprises number of information devices connected to telephone line by HPNA-3 interface and number of telephone sets directly connected to said telephone line ; and

A said telephone cable coupled on subscriber end to said Local Box; and

A number of Subscriber Converters placed into said Local Box; each Subscriber Converter connected to twisted pair of telephone cable and to corresponding flat (or twisted) pair of into-building telephone line to provide a local subscriber loop; each Subscriber Converter comprises an VDSL AFE device connected to said twisted pair of telephone cable, an HPNA-3 AFE device connected to said flat (or twisted) pair of into-building telephone line, a digital VDSL to HPNA-3 Converter device connected to VDSL AFE device and to HPNA-3 AFE device, and a Splitter-Isolator that connected between said twisted pair of telephone cable and said into-building flat (or twisted) pair to separate VDSL and HPNA-3 signals and to provide uninterrupted POTS and (ISDN) service.

4. The communication system of claim 1, comprising a number of Subscriber Converters placed into said Local Box, each Subscriber Converter further comprises a Computer-Server connected to said digital xDSL to HPN Converter device.

5. The communication system of claim 4, comprising a number of Subscriber Converters placed into said Local Box, each Subscriber Converter further comprises an interface digital port , for example Ethernet port , connected to said Computer-Server .

6. The Subscriber Converter of claim 1 further comprising a xDSL AFE IC coupled to twisted pair of telephone cable, a HPN AFE IC coupled to flat (or twisted) pair of into-building telephone line , a digital xDSL to HPN Converter IC coupled to xDSL AFE IC and to HPN AFE IC , and a Splitter-Isolator that connected between said twisted pair of telephone cable and said into-building flat (or twisted) pair to separate VDSL and HPNA-3 signals and to provide uninterrupted POTS service.

7. The Subscriber Converter of claim 6 further comprising a ADSL AFE IC coupled to twisted pair of telephone cable, a HPNA-2 AFE IC coupled to flat (or twisted) pair of into-building telephone line , a digital ADSL to HPNA-2 Converter IC coupled to ADSL AFE IC and to HPNA-2 AFE IC , and a Splitter-Isolator that connected between said twisted pair of telephone cable and said into-building flat (or twisted) pair to separate ADSL and HPNA-2 signals and to provide uninterrupted POTS service.

8. The Subscriber Converter of claim 6 further comprising a VDSL AFE IC coupled to twisted pair of telephone cable, a HPNA-3 AFE IC coupled to flat (or twisted) pair of into-building telephone line , a digital VDSL to HPNA-3 Converter IC coupled to VDSL AFE IC and to HPNA-3 AFE IC , and a Splitter-Isolator that connected between said twisted pair of telephone cable and said into-building flat (or twisted) pair to separate VDSL and HPNA-3 signals and to provide uninterrupted POTS service.

9. The digital xDSL to HPN Converter IC of claim 6 comprising :

First DSP coupled to xDSL AFE IC , to first program memory and to internal RAM ; said DSP realizes a conversion of xDSL signals to information data and vice versa ,

Second DSP coupled to HPN AFE IC , to second program memory and to internal RAM ; said DSP realizes a conversion of HPN signals to information data and vice versa ,

A data exchange controller connected to internal RAM, to first DSP and to second DSP to realize exchange between information data that carries by xDSL and by HPN signals, and:

A control processor connected to first DSP, to second DSP and to data exchange controller to support a communication process and data exchange with external devices.

10. A communication system of claim 5 , further comprising :

A Video-Provider Equipment coupled to number of office xDSL modems placed at Central Office (CO) of Telephone Station and connected to number of twisted pair of subscriber telephone cable on the station end ; and

A number of subscriber premises placed in the building and coupled by flat (or twisted) pair into-building telephone lines to a Local Box, each subscriber premise comprises number of video-information devices connected to telephone line by HPN interface and number of telephone sets directly connected to said telephone line ; and

A said telephone cable coupled on subscriber end to said Local Box; and

A number of Subscriber Converters placed into said Local Box; each Subscriber Converter connected to twisted pair of telephone cable and to corresponding flat (or twisted) pair of into-building telephone line to provide a local subscriber loop; each Subscriber Converter comprises a Computer-Server connected to digital interface port; and;

A Video-Server placed into said Local Box and connected to each Subscriber Converter by said digital interface port; a Video-Server comprises a big capacity memory device that is able to store number of video films and data exchange device that is able to support data exchange between any Subscriber Converter and said memory device; a Video-Server is able to establish communication between said memory device and Video-Provider Equipment using number of office xDSL modems and number of Subscriber Converters those are not busy by customers.

11. A communication system of claim 10 , further comprising :

A Video-Provider Equipment coupled to number of office xDSL modems placed at Central Office (CO) of Telephone Station and connected to number of twisted pair of subscriber telephone cable on the station end ; and

A number of subscriber premises placed in the building and coupled by flat (or twisted) pair into-building telephone lines to a Local Box, each subscriber premise comprises number of video-information devices connected to telephone line by HPN interface and number of telephone sets directly connected to said telephone line ; and

A said telephone cable coupled on subscriber end to said Local Box; and

A number of Subscriber Converters placed into said Local Box; each Subscriber Converter connected to twisted pair of telephone cable and to corresponding flat (or twisted) pair of into-building telephone line to provide a local subscriber loop; each Subscriber Converter comprises a Computer-Server connected to digital interface port; and;

A TV-Broadcast Satellite antenna placed of the roof of said building and connected by coaxial cable to multichannel TV satellite receiver placed into said Local Box and connected to multichannel MPEG Coder to provide number of digital TV channels , and

A Multiplexer connected to said MPEG Coder to realize time multiplexing of number of digital TV signals to high speed data stream; and

A Video-Server placed into said Local Box and connected to each Subscriber Converter by said digital interface port; a Video-Server comprises a big capacity memory device that is able to store number of video films and data exchange device that is able to support data exchange between any Subscriber Converter and said memory device; a Video-Server is able to establish communication between said memory device and Video-Provider Equipment using number of office xDSL modems and number of Subscriber Converters those are not busy by customers; a Video-Server comprises high speed digital interface port connected to said Multiplexer, and Demultiplexer coupled to data exchange device to provide TV-Broadcast service to each subscriber premise.

12. A communication system of claim 10 , further comprising :

A number of multichannel Cable-TV Receivers placed into Local Box and connected by coaxial cable to different Cable-TV Providers ; each Cable-TV receiver connected to multichannel MPEG Coder to provide number of digital TV channels , and

A Multiplexer connected to said MPEG Coder to realize time multiplexing of number of digital TV signals to high speed data stream; and

A Video-Server placed into said Local Box and connected to each Subscriber Converter by said digital interface port; a Video-Server comprises a big capacity memory device that is able to store number of video films and data exchange device that is able to support data exchange between any Subscriber Converter and said memory device; a Video-Server is able to establish communication between said memory device and Video-Provider Equipment using number of office xDSL modems and number of Subscriber Converters those are not busy by customers; a Video-Server comprises high speed digital interface port connected to said Multiplexer, and Demultiplexer coupled to data exchange device to provide Cable-TV service to each subscriber premise.

13. A communication system of claim 10 , further comprising :

A Fiber Opto-Receiver placed into Local Box and connected by fiber to Distribution Box of high-speed data service Provider ; and

A Video-Server placed into said Local Box and connected to each Subscriber Converter by said digital interface port; a Video-Server comprises a big capacity memory device that is able to store number of video films and data exchange device that is able to support data exchange between any Subscriber Converter and said memory device; a Video-Server comprises high speed digital interface port connected to said Fiber Opto-Receiver, and Demultiplexer coupled to data exchange device to provide high-speed data service to each subscriber premise.

14. A method of data and voice communication over existing telephone subscriber local loop, said method comprising:

using xDSL line signals and duplex communication protocol with Frequency Division Multiplexing on cable part of said telephone subscriber local loop,

using HPN line signals and half-duplex communication protocol with Time Division Multiplexing on into-building part of telephone subscriber local loop,

separating xDSL and HPN signals in the point of connection cable part and into-building part of the same telephone subscriber local loop,

conversion of xDSL line signals to HPN line signals and vice versa in the point of connection cable part and into-building part of the same telephone subscriber local loop,

conversion of duplex communication protocol with Frequency Division Multiplexing to half-duplex communication protocol with Time Division Multiplexing in the point of connection cable part and into-building part of the same telephone subscriber local loop,

direct connection between cable part and into-building part of the same telephone subscriber local loop for DC and low frequency voice signals .

15. A method of data and voice communication over existing telephone subscriber local loop, said method comprising:

using ADSL line signals and duplex communication protocol with Frequency Division Multiplexing on cable part of said telephone subscriber local loop,

using HPNA-2 line signals and half-duplex communication protocol with Time Division Multiplexing on into-building part of telephone subscriber local loop,

separating ADSL and HPNA-2 signals in the point of connection cable part and into-building part of the same telephone subscriber local loop,

conversion of ADSL line signals to HPNA-2 line signals and vice versa in the point of connection cable part and into-building part of the same telephone subscriber local loop,

conversion of duplex communication protocol with Frequency Division Multiplexing to half-duplex communication protocol with Time Division Multiplexing in the point of connection cable part and into-building part of the same telephone subscriber local loop,

direct connection between cable part and into-building part of the same telephone subscriber local loop for DC and low frequency voice signals .

16. A method of data and voice communication over existing telephone subscriber local loop, said method comprising:

using VDSL line signals and duplex communication protocol with Frequency Division Multiplexing on cable part of said telephone subscriber local loop,

using HPNA-3 line signals and half-duplex communication protocol with Time Division Multiplexing on into-building part of telephone subscriber local loop,

separating VDSL and HPNA-3 signals in the point of connection cable part and into-building part of the same telephone subscriber local loop,

conversion of VDSL line signals to HPNA-3 line signals and vice versa in the point of connection cable part and into-building part of the same telephone subscriber local loop,

conversion of duplex communication protocol with Frequency Division Multiplexing to half-duplex communication protocol with Time Division Multiplexing in the point of connection cable part and into-building part of the same telephone subscriber local loop,

direct connection between cable part and into-building part of the same telephone subscriber local loop for DC and low frequency voice signals .

INVENTOR :
ROMAN VITENBERG

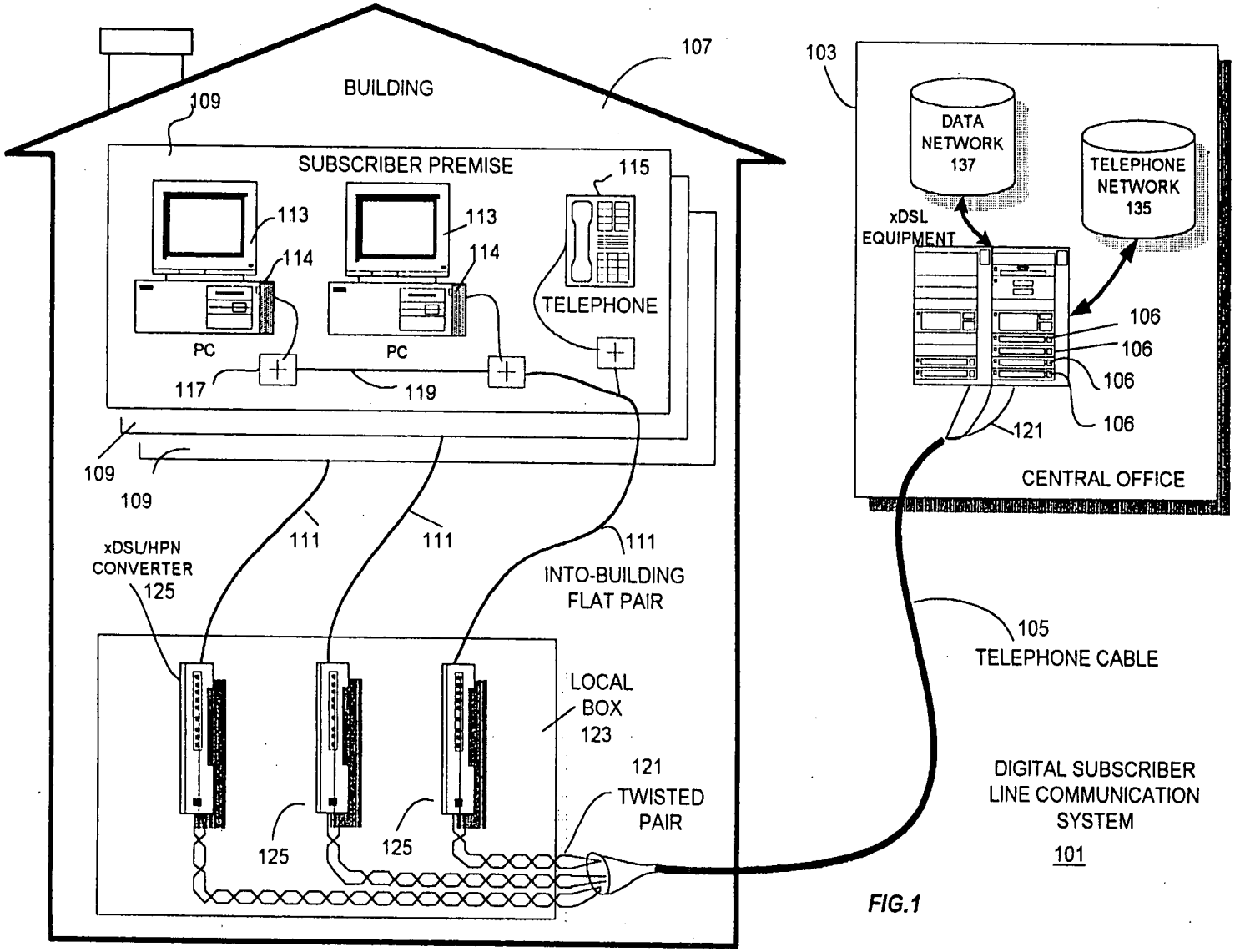

BUILDING
107
109
SUBSCRIBER PREMISE
115
113
113
114
114
TELEPHONE
PC
PC
117
119
109
109
109
111
111
111
xDSL/HPN
CONVERTER
125
INTO-BUILDING
FLAT PAIR
LOCAL
BOX
123
121
TWISTED
PAIR
125
125
103
DATA
NETWORK
137
TELEPHONE
NETWORK
135
xDSL
EQUIPMENT
106
106
106
106
121
CENTRAL OFFICE
105
TELEPHONE CABLE
DIGITAL SUBSCRIBER
LINE COMMUNICATION
SYSTEM
101

FIG.1

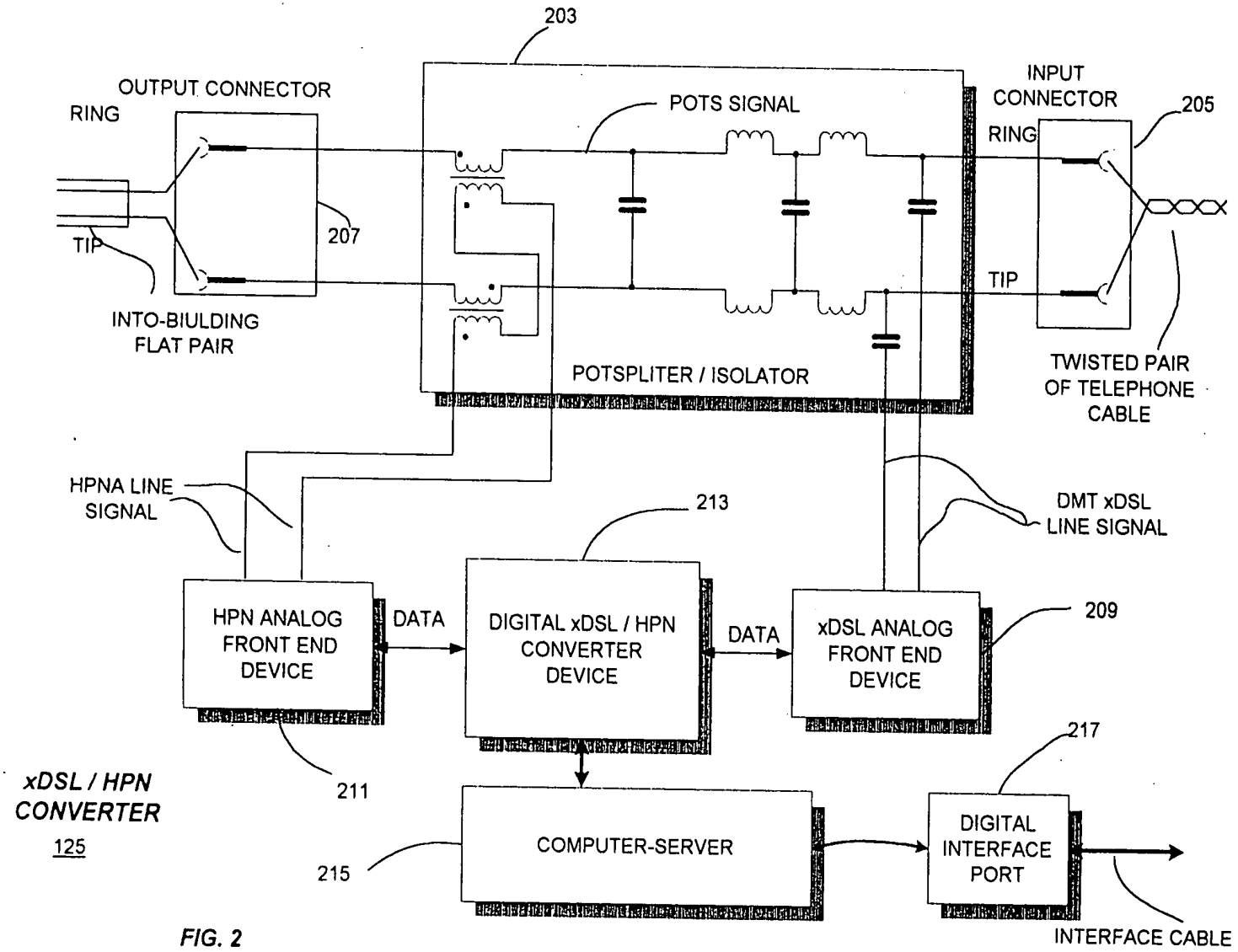

203
OUTPUT CONNECTOR
RING
TIP
207
INTO-BIULDING
FLAT PAIR
POTS SIGNAL
POTSPLITER / ISOLATOR
INPUT
CONNECTOR
205
RING
TIP
TWISTED PAIR
OF TELEPHONE
CABLE
HPNA LINE
SIGNAL
213
DMT xDSL
LINE SIGNAL
HPN ANALOG
FRONT END
DEVICE
DATA
DIGITAL xDSL / HPN
CONVERTER
DEVICE
DATA
xDSL ANALOG
FRONT END
DEVICE
209
211
217
xDSL / HPN
CONVERTER
125
COMPUTER-SERVER
215
DIGITAL
INTERFACE
PORT
INTERFACE CABLE

FIG. 2

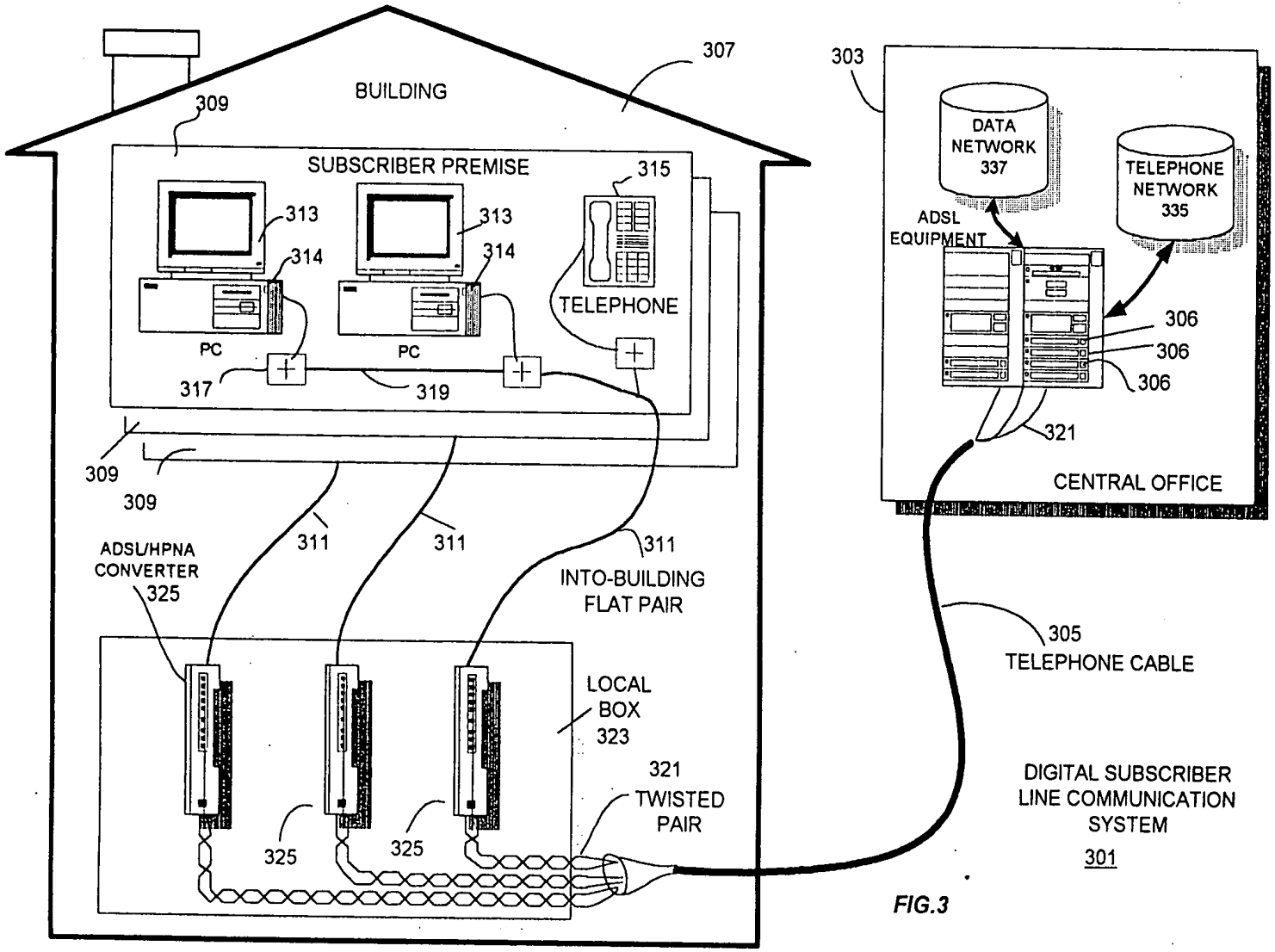

BUILDING
307
309
SUBSCRIBER PREMISE
315
313
313
314
314
TELEPHONE
PC
PC
317
319
309
309
311
311
311
ADSL/HPNA
CONVERTER
325
INTO-BUILDING
FLAT PAIR
LOCAL
BOX
323
321
TWISTED
PAIR
325
325
303
DATA
NETWORK
337
TELEPHONE
NETWORK
335
ADSL
EQUIPMENT
306
306
306
321
CENTRAL OFFICE
305
TELEPHONE CABLE
DIGITAL SUBSCRIBER
LINE COMMUNICATION
SYSTEM
301

FIG.3

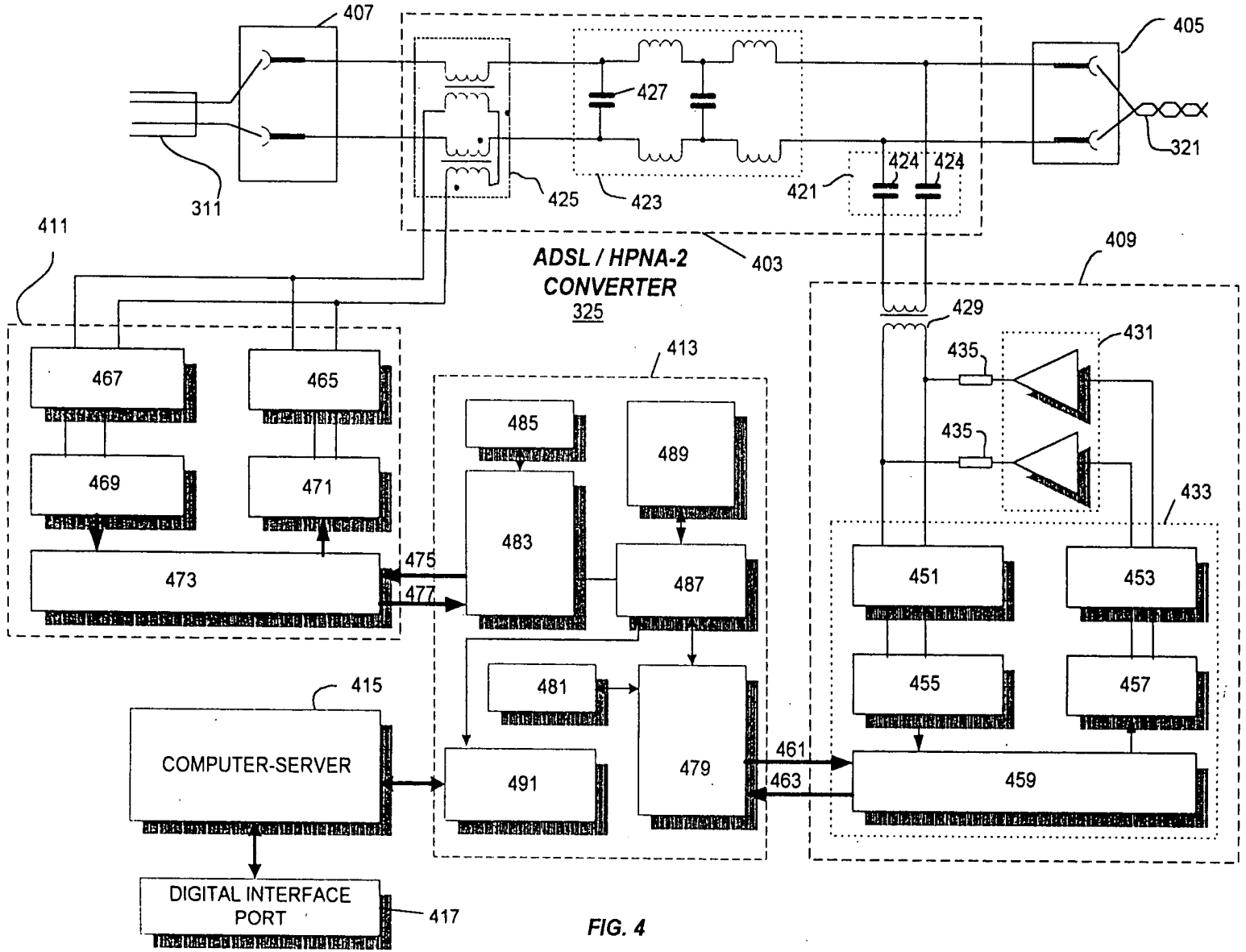

407
405
427
321
311
425
423
421
424
424
411
403
ADSL / HPNA-2
CONVERTER
325
409
429
431
435
435
413
467
465
485
489
469
471
483
433
475
473
477
487
451
453
481
455
457
415
COMPUTER-SERVER
491
479
461
463
459
DIGITAL INTERFACE
PORT
417

FIG. 4

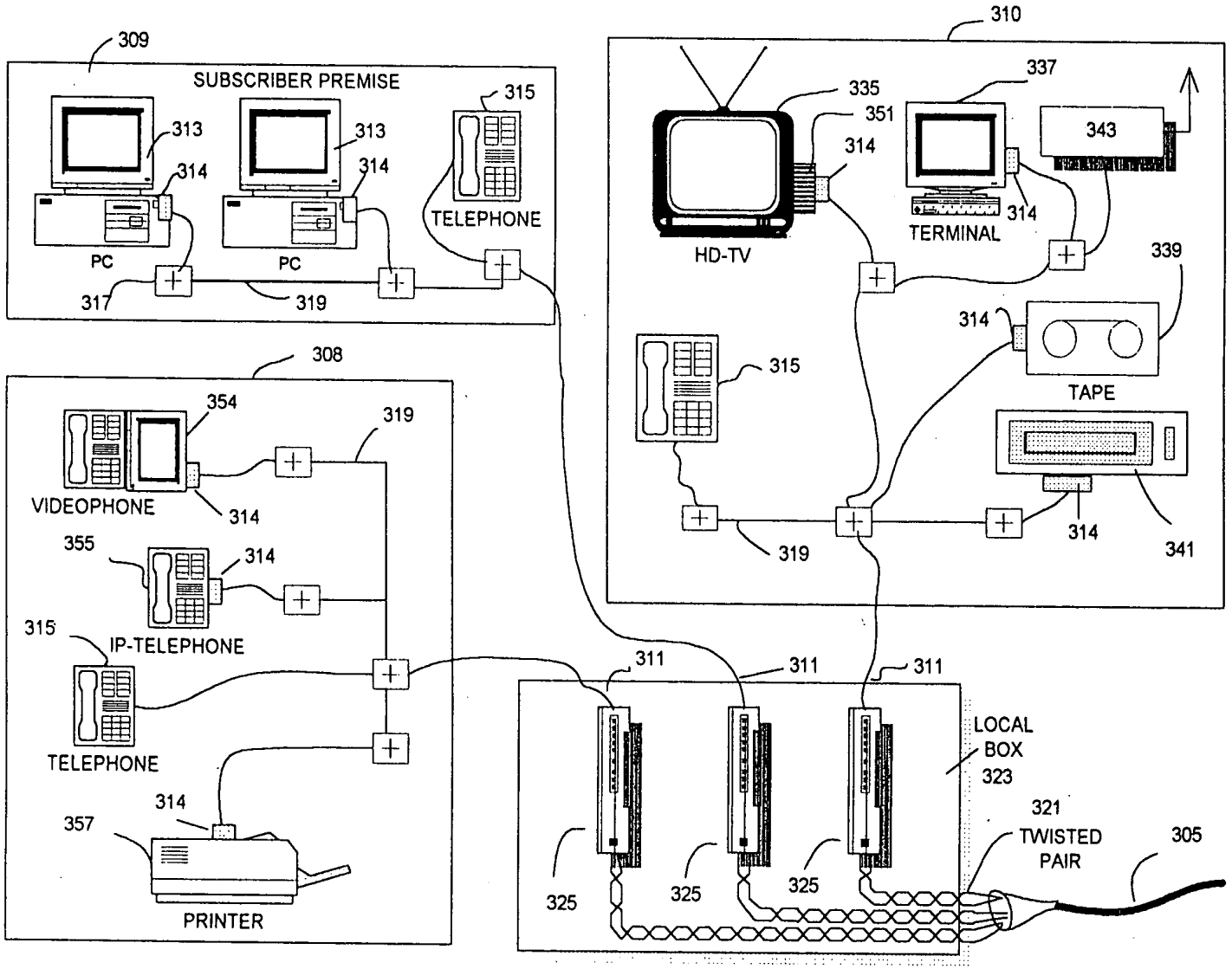

309
SUBSCRIBER PREMISE
313
313
314
314
315
TELEPHONE
PC
PC
317
319
310
335
351
314
337
343
HD-TV
TERMINAL
314
339
314
TAPE
315
319
314
341
308
354
319
VIDEOPHONE
314
355
314
315
IP-TELEPHONE
TELEPHONE
314
357
PRINTER
311
311
311
LOCAL
BOX
323
321
TWISTED
PAIR
305
325
325
325

FIG.5

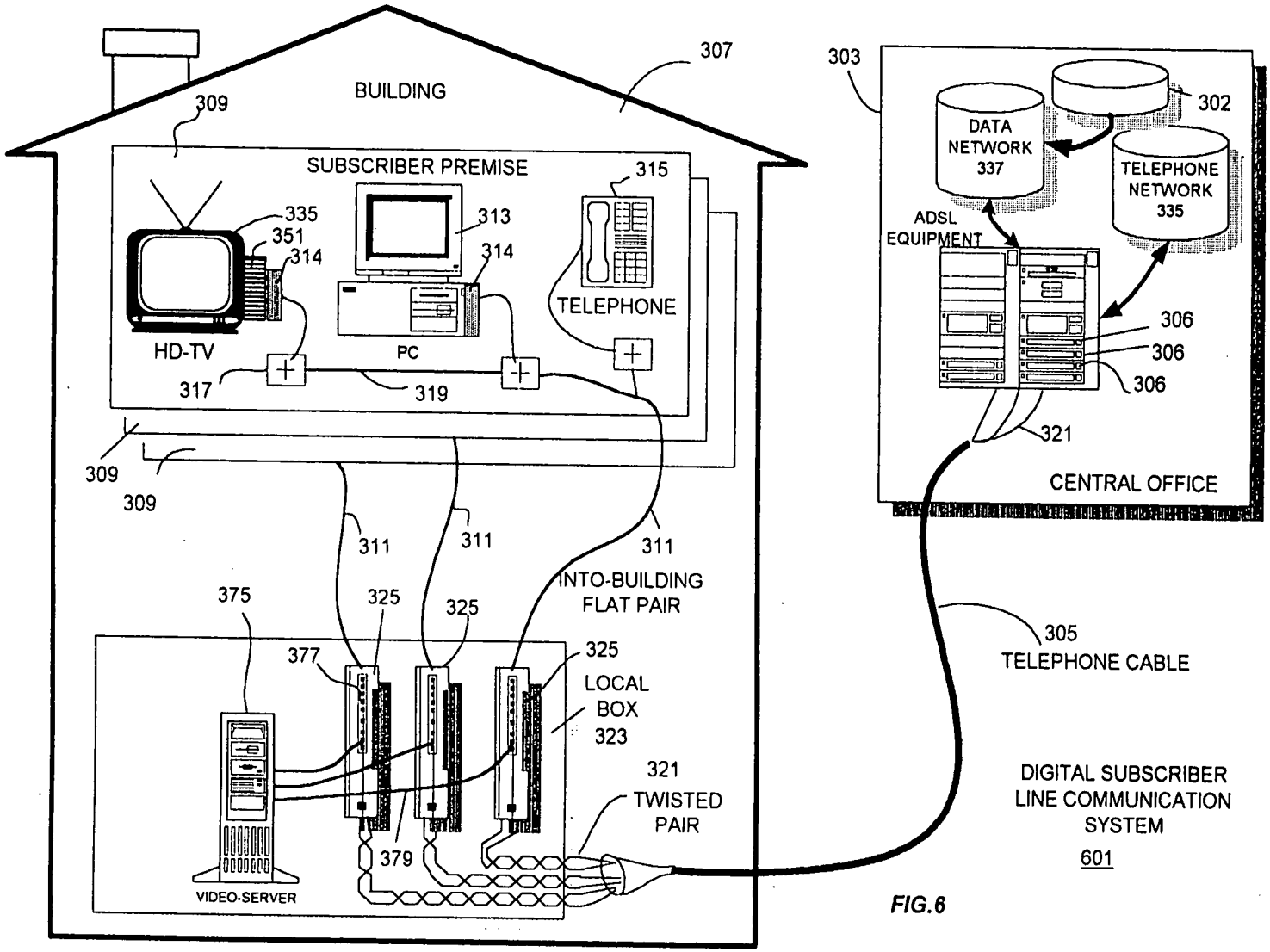

BUILDING
307
309
SUBSCRIBER PREMISE
315
335
351
314
313
314
HD-TV
PC
TELEPHONE
317
319
309
309
311
311
311
INTO-BUILDING
FLAT PAIR
375
325
325
325
377
LOCAL
BOX
323
321
TWISTED
PAIR
379
VIDEO-SERVER
303
302
DATA
NETWORK
337
TELEPHONE
NETWORK
335
ADSL
EQUIPMENT
306
306
306
321
CENTRAL OFFICE
305
TELEPHONE CABLE
DIGITAL SUBSCRIBER
LINE COMMUNICATION
SYSTEM
601

FIG.6

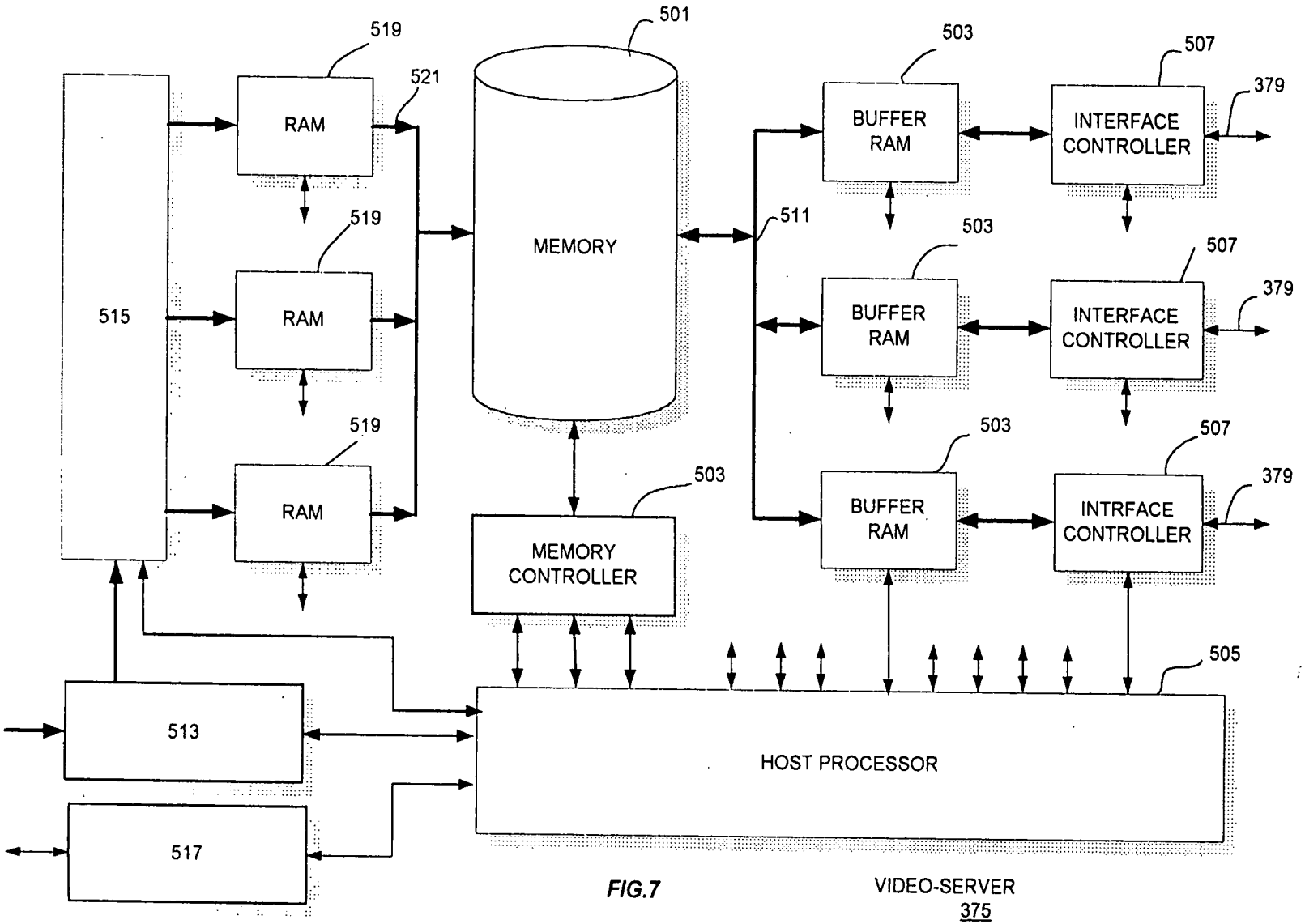


FIG.7

VIDEO-SERVER
375

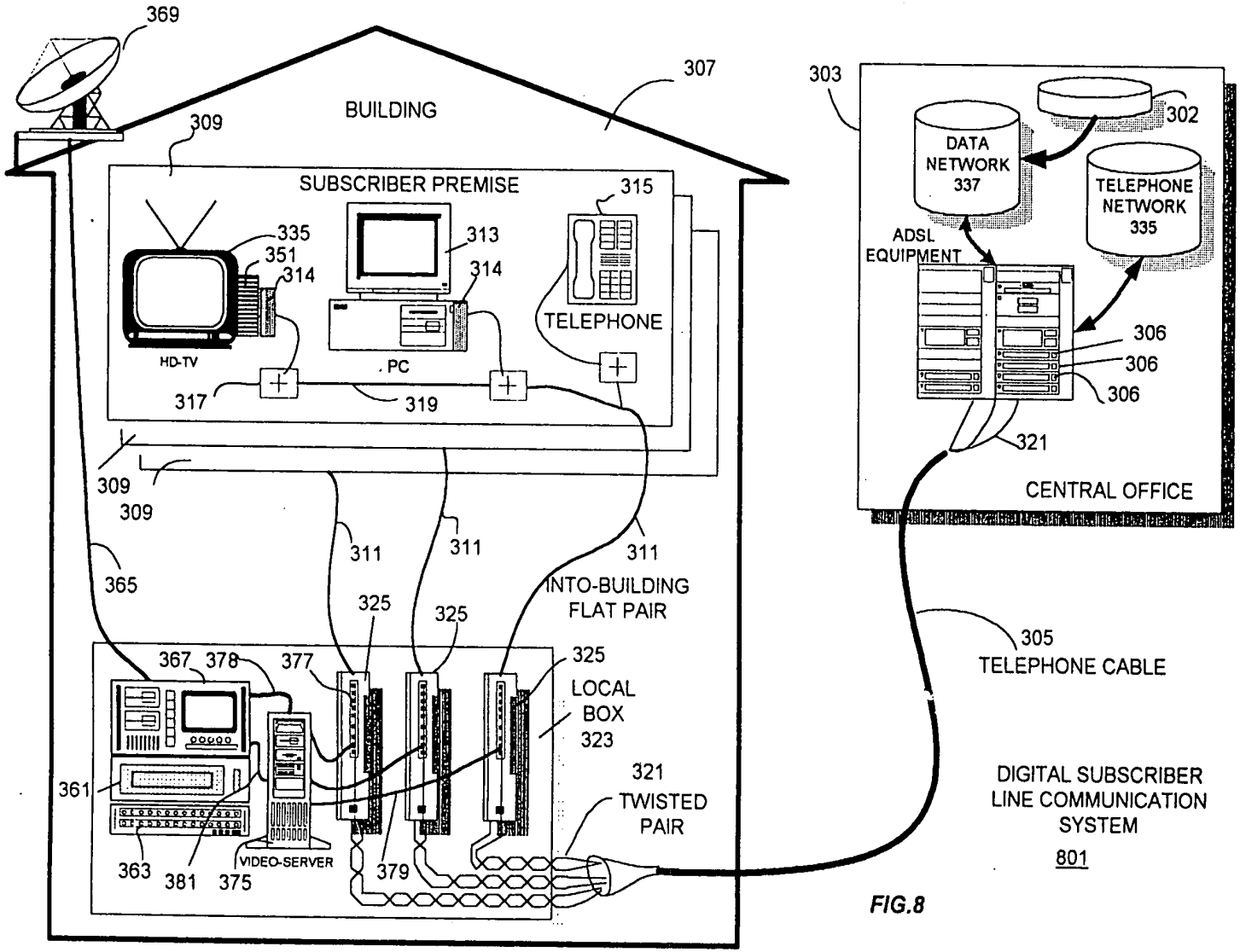

369
BUILDING
307
309
SUBSCRIBER PREMISE
315
335
351
314
313
314
HD-TV
PC
TELEPHONE
317
319
309
309
311
311
311
365
INTO-BUILDING
FLAT PAIR
325
325
325
367
378
377
LOCAL
BOX
323
361
321
TWISTED
PAIR
363
381
375
VIDEO-SERVER
379
303
302
DATA
NETWORK
337
TELEPHONE
NETWORK
335
ADSL
EQUIPMENT
306
306
306
321
CENTRAL OFFICE
305
TELEPHONE CABLE
DIGITAL SUBSCRIBER
LINE COMMUNICATION
SYSTEM
801

FIG.8

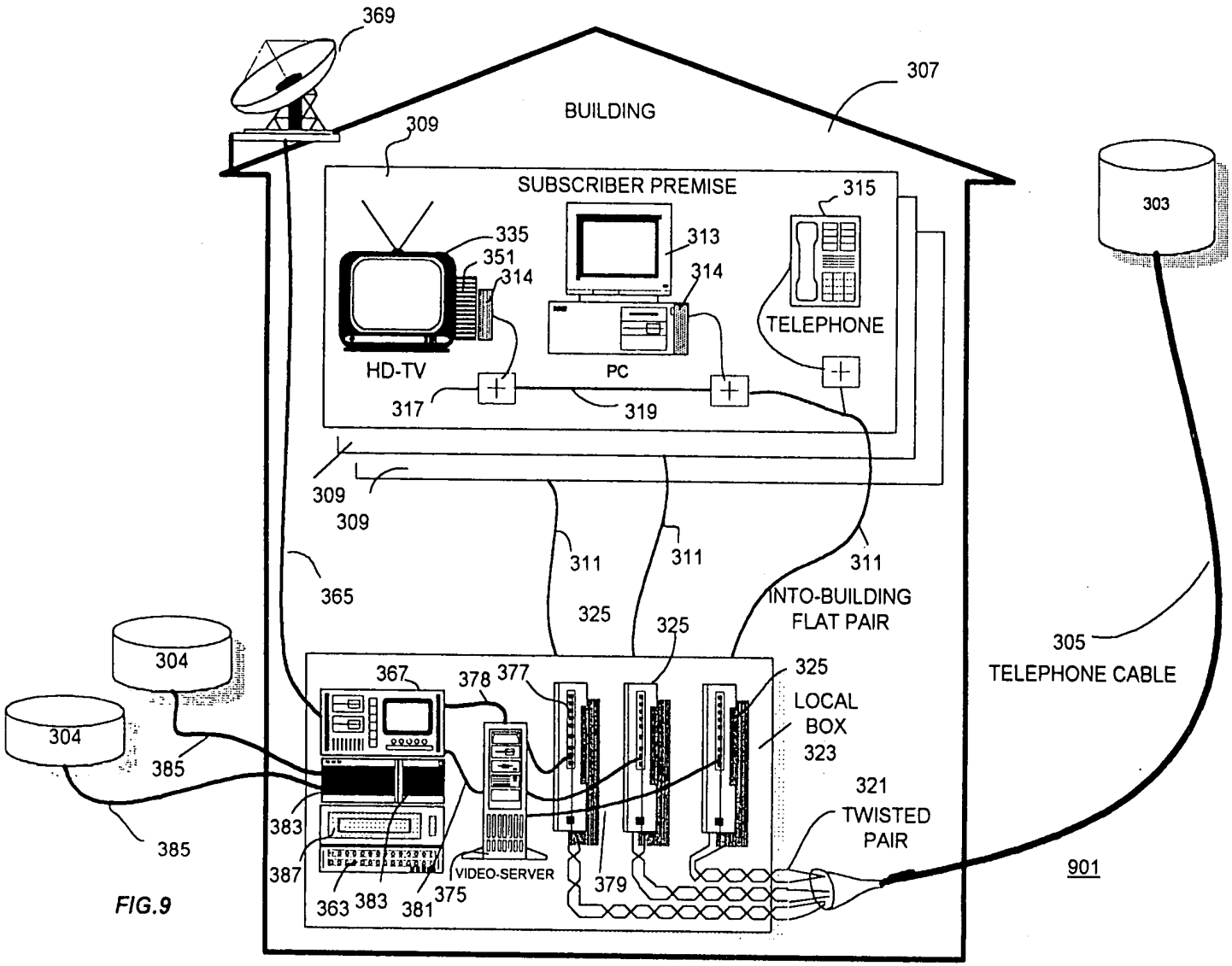

369
307
BUILDING
309
SUBSCRIBER PREMISE
315
303
335
351
314
313
314
HD-TV
PC
TELEPHONE
317
319
309
309
311
311
311
365
325
325
INTO-BUILDING
FLAT PAIR
305
TELEPHONE CABLE
304
304
367
378
377
325
LOCAL
BOX
323
385
385
383
321
TWISTED
PAIR
387
VIDEO-SERVER
379
363
383
381
375
901

FIG.9

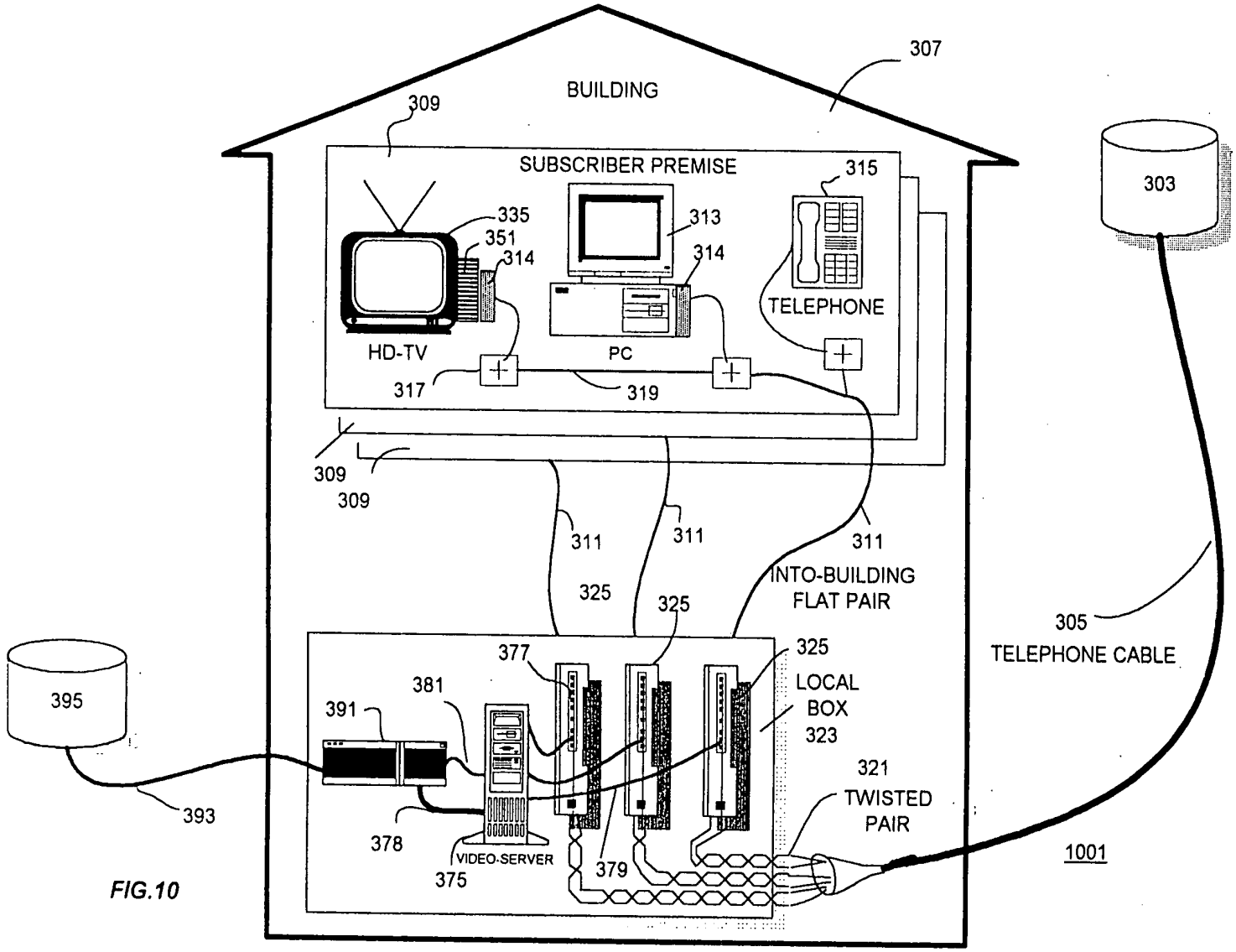

BUILDING
307
309
SUBSCRIBER PREMISE
315
303
335
351
314
313
314
TELEPHONE
HD-TV
PC
317
319
309
309
311
311
311
INTO-BUILDING
FLAT PAIR
325
325
305
TELEPHONE CABLE
377
325
381
391
LOCAL
BOX
323
395
321
TWISTED
PAIR
393
378
VIDEO-SERVER
375
379
1001

FIG.10